# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 17, 1904.

CONTENTS:

*The Continuous Advance of Electrochemistry:* PROFESSOR JOSEPH W. RICHARDS ..... 905

*Distribution of Indian Tribes in the Southern Sierra and Adjacent Parts of the San Joaquin Valley, California:* DR. C. HART MERRIAM ..... 912

*Scientific Books:—*

*The Cryptogamic Botany of the Harriman Expedition:* PROFESSOR LUCIEN M. UNDERWOOD. *Gibbons on 'The Eye, its Refraction and Diseases:* DR. WILLIAM S. DENNETT..

*Scientific Journals and Articles* ..... 920

*Societies and Academies:—*

*The Geological Society of Washington:* ALFRED H. BROOKS. *The Philosophical Society of Washington:* CHARLES K. WEAD. *The New York Section of the American Chemical Society:* DR. H. C. SHERMAN. *The Onondaga Academy of Sciences:* J. E. KIRKWOOD. *The Nebraska Academy of Sciences:* DR. R. H. WOLCOTT ..... 921

*Discussion and Correspondence:—*

*Namatogæan or Epigæan?* DR. WM. H. DALL. *The Blackening of Teeth in the Orient:* PROFESSOR O. T. MASON. *Vegetable Balls:* J. ADAMS ..... 926

*Special Articles:—*

*The Mechanism of the Mont Pelée Spine:* G. K. GILBERT. *A Suggestive Relation Between the Gravitational Constant and the Constants of the Ether:* DR. BERGEN DAVIS.

*The Royal Commission on Tuberculosis* ..... 929

*The International Association of Academies.* 930

*Scientific Notes and News* ..... 931

*University and Educational News* ..... 936

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## THE CONTINUOUS ADVANCE OF ELECTROCHEMISTRY.

THE field of electrochemical activity covers three distinct lines of endeavor: First, the investigation and classification of electrochemical phenomena—scientific progress; second, the formulation of a satisfactory and all-comprehensive electrochemical theory—intellectual progress; and third, the application of these facts to industrial ends—industrial progress. We purpose to discuss briefly this evening the past achievements in each of these lines of endeavor, in order to determine therefrom and to discuss more at length the present bent and probable future direction and extension of each.

### I. THE INVESTIGATION AND CLASSIFICATION OF ELECTROCHEMICAL PHENOMENA.

This is, properly speaking, the real corner-stone of progress in electrochemical science. What has been accomplished in this direction in the century and a half since Beccaria 'revivified' several metals by Leyden-jar discharges may be found scattered through the files of our technical journals and compiled from time to time into compendiums of electrochemical literature. The most pretentious, and in many respects the most timely, of all these works is the 'ausführliches Handbuch,' which our German friends are at present patiently compiling. A careful study of this work causes surprise both at the large amount of investigation which has been done and at the large gaps which exist in our experimental knowledge. Alongside of splendid researches into the most obscure phenomena of the science exist *lacunæ* in

our knowledge of some of the simplest electrochemical phenomena, such as, for instance, in the facts concerning the simultaneous deposition of two or more metals from solution. While doing this the impression grows strong upon us that electrochemistry has lost much because of a lack of cooperation among electrochemical investigators, and because of the desultory, haphazard manner in which their efforts have been frequently applied.

The lack of a coordinating, directing, systematizing influence among electrochemical workers has been the crying need of the science, and it is just this influence, above all things, which is furnished by our electrochemical societies. The Bunsen Society in Germany, the Faraday Society in England, our own society in America have brought electrochemists together, making them acquainted with each other's work, and in particular with the need of experimental work along neglected lines, and have thus furnished the coordinating agency until recently so deplorably lacking.

Davy and Faraday laid broad the experimental foundations of this science by the electrolytic decomposition of many of our most common chemical compounds. Bunsen supplemented this by attacking the rarer metals. Kohlrausch investigated specific conductivities of almost numberless solutions. Beetz and Lorenz fused salts; Moissan the electrochemistry of high temperatures; Hittorf and Ostwald and Nernst the mechanism of electrolysis of solutions, while in between these monumental investigations hundreds of others have contributed to the advance. But still if the army of investigators, as regards numbers, had been in reality an army as regards organization and systematically directed effort, how much more valuable would its work have been! Is it not a fact that one of the results of our semi-annual meetings is that we learn and have impressed upon us the gaps in experimental electrochemistry, and that we often, either deliberately or tacitly, divide the work among us for systematic investigation?

Let me indicate some of the many electrochemical subjects which need systematic attack and orderly study. The electric conductivity of some common salts is as yet undetermined, not to mention most of the rarer ones. Braun, Graetz and Poincairé did good work on the conductivity of fused salts many years ago, but for every salt they tested there are a dozen or a score awaiting investigation. The results of the electrolysis of solutions of different salts, of different concentrations, at different temperatures, with differing electrodes and current densities, has been merely touched here and there; the great body of that information is ripe for harvest to whoever can wield the sickle. The study of the electrolysis of fused salts, or of solutions of chemical compounds dissolved in fused baths, is scarcely begun. One can go into the laboratory any afternoon and start an electrochemical study of a salt which has never before been taken up, and there are enough such to keep the laboratory busy a long, long time.

The use of accurately controlled electrodeposition for the purpose of determining the chemical equivalents of the metals is a method which has not received the attention which it deserves. It is quite certain that the atomic weights of many elements, whose exact value is at present uncertain, could be fixed satisfactorily in this manner. The calorimetric investigation of electrolytic cells in operation, inaugurated by Faure, is an attractive field wide open for the experimenter, and from which much valuable information could be drawn. Besides these, the deposition of alloys, the solution of alloys, the electrolysis of mixed electrolytes, the function of intermediate (bi-polar) electrodes, the exact *modus oper-*

*andi* of porous diaphragms, the relation of viscosity to electric conductivity and ionic mobility, the limitation of the speed of electrolysis by the diffusibility of the products, the solubility of metals in their own fused salts, the function of gases in solution, the compounds of solvent with solute and their relations to complex ions and the mechanism of electrolysis, are only some of the many phenomena whose investigation has only begun, and which lie invitingly before us. Professor A. A. Noyes has blazed a new trail by his systematic work on the electric conductivity of solutions at high temperatures, and Dr. Kahlenberg by his researches on the electrolysis of non-aqueous solutions. Let these advise us that there are as many new fields awaiting attack as there are old ones needing thorough exploration.

In the whole realm of pure science (meaning thereby the investigation and classification of phenomena) there is no field offering more attractions at the present moment, none more ripe for exploitation, none more promising of large rewards for honest work, than electrochemistry. The science is yet in its infancy; many of its pioneers are yet living (the original patentee of nickel plating contributes a paper to this very meeting), and the gates of opportunity are opened wide to every one of us to go do likewise—to become pioneers in our turn.

## II. THE BUILDING OF A COMPREHENSIVE ELECTROCHEMICAL THEORY.

In this respect we must confess at the outset that our science is in a state of transition. We know what we are abandoning, we hardly as yet grasp the newer theory to which we are groping our way. In the past plausible explanations have been advanced which fitted the known facts fairly well, only to be afterwards shattered by new facts which could not be made to fit into the theory. Scientific theories must enlarge to fit the new truth or be broken by it, and so our theories must be in a state of constant flux if the science to which they belong is a live, growing science, receiving continually accretions of new truth.

Not very long ago the burning electrochemical question was, 'Is the theory of electrolytic dissociation the true explanation of the nature of a solution?' I shall not say that it is not, because I do not know; but I am certain that the man is making a mistake, whoever he may be, who says that 'it is certainly true.' My own conception of the state of solution is that the solute is in an abnormal *physical* state, having resemblance to the gaseous state, and that in some cases a definite compound of the solute with the solvent exists in the solution, it also being in the abnormal physical state, but not abnormal chemically. The grounds for this view would take too long to explain, but they appear to me to point to this as an explanation more satisfactory than the assumption of an abnormal chemical condition of dissociation.

Large generalizations like the theory in question, however, are very seldom directly proven false; the evidence of their insufficiency simply accumulates until the conviction arises or grows in men's minds that something else explains the facts better, and the older theory thus fades into the background. At the present time the physical chemist, or perhaps rather the chemical physicist, has thrown so much light upon the structure of the atom by his discoveries regarding electrons that it appears as if a new and a very brilliant side-light is about to be thrown upon the subject of electrochemical phenomena. If it be true, as Professor J. J. Thomson has apparently just proved, that the arrangements of the elements in families according to the periodic law, their periodic increase and decrease in valence, and change from electropositive to electronegative character, can

be postulated as a necessary deduction from the hypothesis of the atoms consisting of uniform shells of positive electricity, inclosing negative electrons arranged in rotating rings, then the ionic conception will of necessity yield place in electrochemical science to the electronic. In this connection it ought to be noted that Professor Thomson's inferences as to what constitutes chemical combination, the electrically neutral atoms losing or gaining electrons and thus becoming positively or negatively electrified, and therefore attracting each other, agree with and supplement to a nicety the system of positive and negative bonds elaborated twenty-five years ago by our respected member, Professor O. C. Johnson.

The nature of the act of solution bears so fundamentally upon the mechanism of electrolysis that light thrown upon it from any direction is very welcome. Professor J. H. L. Vogt, of the University of Christiania, has recently published the first section of a work on the nature of fused silicates which bears so directly upon the question of fused baths, and particularly of the condition of compounds dissolved in fused baths, that the close study of his work will undoubtedly assist the electrochemist in understanding fused bath electrolysis and, in fact, the problem of solution in general. It is, indeed, the fact that many bases dissolved in fused silicates retain their chemical individuality, and can be proved to exist there simply in an abnormal physical condition. The analogous process in regard to solution in water passes current under the name of ionization, or electrolytic dissociation. From these and similar investigations the conviction is being pressed upon us that physical solution of one substance in another covers a large part of the field formerly supposed to be entirely chemical in its nature, and that the eutectic mixtures resulting are in no sense chemical compounds, but that the latter constitute nodes or critical points of the mixtures, while in between, in the ordinary run of solutions, we are dealing simply with these chemical compounds mutually dissolved in each other, and in no other states than abnormal *physical* states. The electrolysis of a substance in solution means usually, therefore, the decomposition of that chemical substance existing in an abnormal physical state, and not the act of gathering at the electrodes the ions of the previous dissociated chemical compound.

These are the personal views of your speaker, and are, of course, not put forward as necessarily representing those of any other member of this society. They are given here because I believe that the advance in electrochemical theory in the near future will be in this direction and along these lines.

### III. APPLICATIONS TO INDUSTRIAL NEEDS.

If electrochemistry concerned itself only with the study of phenomena and their classification, the deduction of laws and the building of theories thereupon, it would satisfy one of the fundamental needs of the human mind, that of *knowing,* but would leave unsatisfied another and equally vital desire, that of *using.*

As one indication of this we see the program of our meeting classified into experimental, theoretical and industrial. (I stand convicted of having plagiarized the plan of the program in laying out the subjects of my address.) Without the latter item the electrochemical field would remain a thing apart from the sympathy of the world at large, and it is really by reason of the absorbing interest and great economic value of these industrial applications that we have with us the support and cooperation of the educated and the commercial world.

The various items in which, in industrial chemistry and metallurgy, electrochemical

methods have either superseded ordinary non-electric methods, or else have created new industries, form a catalogue sufficiently long to arrest the attention of the most superficial observer, and altogether too long to be mentioned in detail within the limits of this address. Suffice it to mention in passing the millions of dollars' worth of copper electrolytically refined, not annually, but monthly; the 100,000 horse-power consumed in producing calcium carbide; the reduction of the cost of aluminium from $5 a pound to 30 cents; of sodium in almost an identical ratio; the revolution being wrought in one of the largest chemical industries by the production of electrolytic alkali and bleach; the capturing of the potassium chlorate industry and the manufacture of phosphorus.

The whole story, if related at length, would be the old story of *homo sapiens* having discovered a new tool, a new instrument wherewith to torture mother nature; a new means of reaching old or of creating new results, and he is necessarily immersed in enthusiasm for this 'genius of the lamp,' which has performed so many wonders and promises so many more. For the use of electricity puts at our disposal temperatures never before industrially attained; gives us a decomposing agent at whose bidding the most powerful chemical compounds resolve into their constituents; enables us to attack and solve chemical problems in a manner before unthought of; opens up a world of possibilities whose scope we even yet but dimly comprehend. This is the fascination of the subject, the attractive force, the absorbing interest which is reflected in the enthusiasm of the electrochemist for his profession and in the gratifying success which has attended the formation and growth of this electrochemical society.

It remains to speak, with as much definiteness as the subject permits, of the possible enlargement and extension of these industrial applications. 'Whither' is a more important question than 'whence' when the present prosperity and future progress of the art are concerned.

Basing our remarks upon present developments, it may be perceived, to start with, that the electrical methods in chemistry and metallurgy which are most successful are either, *first*, those applied to the more powerful chemical compounds, whose decomposition by non-electric methods is highly difficult and expensive, or else impossible; or, *second*, those applied to new fields of very high temperature reactions impossible of attainment by other means, or, *third*, those applied to ordinary chemical processes, in which the directness of the electrical influence, be it decomposing, reducing or perducing, can not be duplicated or competed with by known non-electric methods.

Primitive man took his first lesson in metallurgy by learning to make iron; to this the ancients added lead, copper, silver, gold and even the volatile mercury. Many centuries later zinc was distilled, and only in the most recent times have sodium, aluminium and magnesium been possibilities. Painfully and slowly alchemy and modern chemistry toiled up the heights of the electrochemical series, from the easy conquest of the *noble* metals to the powerful mastery of the *strong* metals, and the steepest part of the ascent has been lightened by the aid of electricity, which has in many cases furnished the easy path to the conquest of the most difficult chemical problems.

It is related of our renowned geologist, Clarence King, that he was an enthusiastic mountain climber, and having from a distance spied a steep mountain, he conceived the ambition of conquering it. Taking a respite from surveying, he equipped himself for difficult climbing, and after several

hours of desperate effort finally stood on the summit of the seemingly impregnable butte, only to find an easy trail leading up on the other side.

The most abundant materials in nature are the fixed, difficultly transposable compounds of the strong metals, and their conquest and utilization are the peculiar and special province of electrochemistry.

According to the estimate of the indefatigable chemist of the Geological Survey, F. W. Clarke, silicon oxide forms 58.3 per cent. of the contents of the solid crust of the earth, aluminium oxide 14.7 per cent., iron oxide 7.8 per cent., calcium oxide 5.3 per cent. and magnesium oxide 4.5 per cent.; or, expressed in another way, silicon 27.2 per cent., aluminium 7.8 per cent., iron 5.5 per cent., calcium 3.8 per cent. and magnesium 2.7 per cent.

With these figures in mind, may I not ask whether we fully realize the significance of one of the latest electrometallurgical triumphs, the production of metallic silicon on a large scale in the electric furnace by one of our Niagara Falls members, Mr. F. J. Tone? While the catalogues of dealers in rare chemicals are still listing silicon at dollars an ounce, an electrochemist has two barrelfuls of it which he is wondering if any one will buy at a fraction of a dollar a pound! Could anything better illustrate the revolutionary character of electrochemistry? While the electrochemist is the reverse of a nihilist, we must admit that he is a typical and convicted revolutionist.

To say a word or two more about silicon. I had a somewhat uncanny feeling when Mr. Tone introduced me to his half a ton of silicon. "Here is," I soliloquized, "the first chance which mankind has had to utilize the most abundant solid element on earth. What will be made of it? Can it become as useful as iron? Probably not. Can applications be found for it which will bring it among the ordinary metals of every-day life? Possibly. In any event, here is the material, ready to hand, and no one but the electrochemist could have made it."

Something of the same feeling must have arisen in the mind of the chemist who first made aluminium a commercial possibility, but his expectations, based on his chemical process, were only actually realized when the electrochemist gave his solution of the problem. This very element illustrates one of the chief characteristics of electrochemical processes, viz., their potentiality for improvement. Chemically produced aluminium was out of the race when the metal sold for one dollar per pound, yet the present market price is only one third of that. After the chemical process has done its utmost, has said its last word, the electrochemical process, which supersedes it, has only *begun* its march of improvement.

In the metallurgy of iron, a direct replacement of the ordinary manufacture of pig iron by electrical processes is very far from a possibility, even in countries where coal is most expensive and water power most abundant. However, in the manufacture of that higher-priced product, steel, the case is different, and already some of the finer qualities, such as replace crucible steel, are being made electrically in France, Switzerland and Sweden. It is only a question of some more inevitable improvements being made in the electric furnaces used to make possible the manufacture in them of the more common and cheaper varieties of steel. This will come at first in countries where fuel is dear and power cheap, and afterwards in localities where very cheap power is being generated by gas-engines using either the waste gas from blast furnaces or producer gas made from coal waste or culm.

Even before that time the auxiliary use

of electric heating to take off the 'peak of the load,' so to speak, in our open-hearth steel furnaces—that is, to furnish the last few hundred degrees of necessary temperature while the combustion of gas furnishes the lower range—is a distinct commercial possibility. Already our steel works are a network of electrical appliances for running cranes, charging machines, hoists and cars, and the step is not a long one to employ this already-present agent to help the heating gases over the heaviest part of their work, the bringing up of the charge to tapping heat.

Next to iron in natural abundance is calcium, and our chemists and metallurgists are only beginning to appreciate its possibilities. Occurring as almost chemically-pure calcium carbonate, in inexhaustible quantities and at the cost of only a few cents a ton for quarrying, the question of producing the metal cheaply is the particular task of the electrochemist. The cost of the metal is practically the cost of its reduction, and there is no doubt that the electrometallurgist can and will solve this question as he has that of aluminium and silicon. Calcium is, at temperatures above a red heat, the strongest metallic base existing, and is therefore the most powerful pyrochemical reagent. By its use many problems may find their solution, such as the complete deoxidation of melted metals, the reduction of rare elements and many other interesting reactions.

Magnesium does not occur quite so plentifully as calcium, but still it is so common that 99 per cent. of the present cost of making magnesium must be charged against the process used and only 1 per cent. against the raw material. There is no reasonable doubt but that careful study put upon the electrolytic production of magnesium would result in its being produced at a fraction of its present cost. It is certainly a metal which, at its present price, has very limited uses, but, with a specific gravity of only 1.72, a capacity for being hardened and strengthened like aluminium and the property of forming valuable alloys with copper and with aluminium, it is certain that its cheap production would mean another metal added to those in everyday use.

There is yet another metal of kindred character worth considering. Beryllium occurs in the gem beryl as silicate of aluminium and beryllium. The mineral is found massive in large enough quantities to form a commercial source of the metal. The separation of the beryllium oxide from the silica and alumina is not a very difficult chemical operation, but could probably be simplified by the application of Hall's process of differential reduction in the electric furnace. The reduction of beryllium oxide to metal dissolved in a fused bath of alkaline and beryllium salt is a step which would probably yield to investigation, while the collecting of the metal floating upon the bath should offer no greater difficulties than does the collecting of sodium.

With a brilliant white color, specific gravity 1.6, malleable, ductile, forming fine alloys, there are a large number of possible applications for beryllium if it can be obtained cheaply, and it is to the electrochemist that we must look for the solution of this problem.

In the electrolytic refining of metals, copper was the first to yield commercial results, silver next, then gold, lead and bismuth. Yet there are others awaiting conquest. The electrolytic refining of nickel, zinc, antimony and tin has been attempted, but not yet commercially mastered; that of aluminium is an attractive question because of the economy it would produce. Instead of purifying by costly chemical methods four tons of aluminium ore, we have the alternative problem of refining one ton of impure aluminium, and with a large margin of difference in com-

mercial value to work upon. It may be, since electrolysis in aqueous solutions appears impracticable, that refining in non-aqueous solutions, or in easily fusible salts, would conquer the difficulty.

In the field of producing ferro-alloys of the rare metals, for use in making special steels, even the crude electric furnaces in present use have demonstrated their ability to produce these alloys at the minimum cost. Here is a field which has been practically occupied by electric-furnace methods, or by the Goldschmidt process, using electrolytically produced aluminium, and one does not need to be much of a specialist in chemistry or metallurgy to see the wide vista of commercial opportunities here opening before us.

While our largest electrometallurgical industry is that of copper refining, the largest industrial electrochemical operation is that of producing calcium carbide. Calcium carbide, a substance practically unknown to even the skilled chemist a few years ago, and now being produced by thousands of tons annually. Calcium carbide, the commercial key to the gateway first pointed out by Wöhler, when he made artificial urea.

But why only *calcium carbide?* This is only one of the numerous carbides first produced commercially by electrical methods. Silicon carbide is another which has found broad applications and formed a new industry, and it is not only possible, but most probable, that other metallic carbides may find large applications. Moissan has shown, for instance, that uranium carbide produces, with water, liquid hydrocarbons like petroleum, and the production of artificial petroleum is a scientific possibility, although not at present commercially practicable. Besides the carbides, there are other electric-furnace products—the metallic nitrides, which are awaiting further study and utilization.

One of the most vigorous and industrious electrochemists said to me once, "We are so overwhelmed by new things of possible use to science or industry that we can at most investigate only a small fraction of them. It is a virgin continent of undeveloped possibilities."

Of the possibilities of the direct preparation of metallic compounds from the metals, the transformation of metallic salts into other compounds, the fixation of the nitrogen of the air, the increased application of the simple, direct and elegant methods of electrolytic decomposition, reduction or perduction in organic chemistry, the electrification of soils and its influence on agriculture, the sterilization of water by electrically made ozone and the disinfection of sewage and their contribution to sanitary science, and the various other unmentioned possibilities of electrochemistry, time literally fails in a simple endeavor to mention, let alone to discuss them.

The great services which electrochemistry has rendered humanity, and the march of civilization in the past decades which measure its brief but phenomenal advance, are but a fraction and an earnest of what is yet to be accomplished. If in the battle of industrial competition you are summoned by the conservatives of industry to strike your colors, answer with the courage and determination of the intrepid Captain John Paul Jones, 'Surrender, sir! We have only begun to fight.'

Joseph W. Richards.
Lehigh University.

## *DISTRIBUTION OF INDIAN TRIBES IN THE SOUTHERN SIERRA AND ADJACENT PARTS OF THE SAN JOAQUIN VALLEY, CALIFORNIA.*

The distribution of Indian tribes in California has never been completely worked out. This is due partly to the difficulty of the undertaking but mainly to the inadequate amount of field work thus far

done in the state. The principal contribution to the subject is Stephen Powers's 'Tribes of California,' published in 1877. Powers's field work was done in the summers of 1871 and 1872, supplemented by a collecting trip in 1875 or 1876. The time at his disposal was limited, and most of it was given to the Indians of the northern half of the state, those of the southern half receiving very little attention. In discussing the distribution and relations of the southern tribes he was several times led into error, and in certain instances even referred to one stock tribes belonging to another. These errors were copied by Powell in his 'Indian Linguistic Families,' 1901.

Powers's work contains a large map showing the distribution of linguistic stocks in California, though it does not give quite all that are mentioned in the text. In the matter of nomenclature it obviously was worked over by Powell.

In 1891 appeared the Powell-Henshaw map of the linguistic stocks of North America, the California part of which is only slightly modified from Powers's map of 1877, the principal changes being in the names used for the stocks. In 1903 Dixon and Kroeber published a small map of the linguistic families of California, which, though not so credited, is copied from the Powers and Powell-Henshaw maps, with slight alterations on the northwest coast and a few changes in nomenclature. All of these maps are so generalized, particularly in the southern half of the state, that they fail to show the real boundaries of the areas and make no attempt to indicate the localities at which Indians actually live. They are misleading in that the areas allotted to the various stocks cover the entire area of the state, leaving no spaces between and no parts unoccupied. It is true that in many cases tribes were so numerous as to press closely upon one another, with definite boundaries between; but in other cases they were widely separated and there were large tracts wholly unoccupied.

The distribution of Indians conforms closely with that of the faunal and floral areas. Zoologists and botanists have found that animals and plants are arranged in definite belts the boundaries of which are determined by climatic conditions. In the northern hemisphere north of the tropics the northern zones are called Boreal, the southern Austral. In North America the Austral zones are called Lower Sonoran, Upper Sonoran and Transition; the Boreal zones, Canadian, Hudsonian and Alpine. In California no Indians live in the Boreal zones, and few if any in the upper half of the Transition zone, though certain tribes claim parts of these as summer hunting grounds. The great majority live in a single life zone—the Upper Sonoran; many in the Lower Sonoran, and a few in the Transition. The Lower Sonoran comprises the hot San Joaquin-Sacramento plain and certain outlying valleys, the Colorado and Mojave deserts, and small areas in the southern part of the state; the Upper Sonoran comprises the foothill or Digger pine belt of the Sierra, most of the coast ranges and valleys, most of the desert region of eastern California north of Owens Lake, and the greater part of southern California west of the desert; the Transition comprises the yellow of Ponderosa pine belt of the Sierra, the corresponding belt of other mountains, and a narrow strip along the humid coast.

For several years I have been engaged in mapping, for the U. S. Biological Survey, the distribution of plants and animals in California. This work takes me into all parts of the state so that I frequently come across camps of Indians belonging to different tribes. These tribes are so little known, and are disappearing so

rapidly, that I have felt it a duty to stop, whenever practicable, long enough to secure short vocabularies and find out who the various people are. Some are now on the verge of extinction and several are represented by only one or two living individuals. It is obvious, therefore, that whatever is to be learned from them must be learned at once.

Persons unfamiliar with this kind of work may be interested to know that the classification of tribes and stocks is based wholly on language. In most cases the numerals alone are sufficient for the purpose, but it is well not to rely on them too implicitly, for in certain cases they, as well as many other words, are strongly affected by contact with neighboring tribes. This is particularly true of remnants of tribes whose altered conditions have brought them into friendly intercourse with tribes with whom they were not formerly on terms of intimacy. Thus members of two disappearing California tribes (Ko-ko-he'-ba and Kosh-sho'-o) at first gave me numerals belonging to different linguistic families from those to which they respectively belong; but when their attention was called to the matter they promptly corrected the mistake. In another class of cases the effects of contact are so firmly incorporated into the language that the persons speaking do not realize that they are using borrowed words. Thus the Pakanepul of Kern Valley, assumed to be of Paiute origin because four of their numerals (2, 3, 5 and 6) and a few other words resemble or suggest those of the Paiutes, gave for 7 the Yokut word *num-chin*. This was not an accidental use of the word, for it was given me by three persons at different camps. Besides the numerals, it has been my practice to collect terms of relationship, names of animals and plants, and vocabularies of several hundred of what seem to be the more important words.

In the Sierra region the distribution of tribes conforms closely with certain faunal belts. The higher and colder belt, comprising the Boreal zones, is not inhabited, and only a few tribes go so high as the lower half of the Transition zone, most of them living in the Upper Sonoran or Digger-pine belt, which occupies the lower slopes and foothills. All the way from Sacramento canyon to Tehachapi, a distance of about 500 miles, fully 95 per cent. of the Sierra Indians dwell in this life zone. Most of the tribes live wholly within it and not one lives wholly above it.

The Southern Pacific Railroad crosses the Sierra Nevada between the Yuba and American Rivers in the territory of the Nis-se-non (or Nishinam), a branch of the so-called Midu (Mi-doo) stock. The Nissenon reach from Bear River on the north to the Cosumne River on the south. South of the Cosumne are the Mu-wa, called by Powell 'Moquelumnan.' The Muwa are one of the largest stocks in California. Their territory embraces the Upper Sonoran and lower half of the Transition zone of the west flank of the middle Sierra from the Cosumnes to Fresno Creek—a distance of 110 miles.

South of the Muwa, and ranging from Fresno Creek to Kern Lake and Tehachapi Basin, are tribes of two widely different linguistic families—Yo-kut and Pai-ute. These tribes are arranged in the main in parallel belts, the Yokuts occupying the lower and more westerly country, the Paiutes the higher and more easterly. But there is this important difference: The Yokut tribes are numerous, and until the confiscation of their lands by the whites their distribution was continuous, while the Paiute tribes are few and their distribution is and always was interrupted by broad intervals. Powers recognized the general facts that the Indians of this part of California belong in the main to the Yokut and

Paiute stocks; that the Yokut tribes were a peaceful people and were the earlier occupants of the region; and that the Paiute tribes were more powerful and warlike and entered at a later period. He states that bands of Paiutes, leaving their desert homes east of the mountains, had pushed through the passes of the Sierra, invaded certain valleys of the west slope, and driven out the Yokut people.

Tribes of other linguistic families inhabited the hot Tulare-Kern Basin and the region to the west and southwest, but they do not come within the scope of the present paper.

In the area south of Fresno Creek I have obtained vocabularies from eighteen tribes, of which nine are of Yokut origin and nine of supposed Paiute or Shoshonian origin.

### THE YOKUT TRIBES.

The country of the Yokuts comprises the eastern part of the San Joaquin Valley and adjacent lower slopes of the Sierra from Fresno Creek southward to the Bakersfield Plain. Their villages, when the whites first visited this part of California, were numerous and prosperous, and the territory claimed by the various tribes spread continuously from one end of the area to the other. The tribes were most numerous in the Kaweah Delta region and on Kings River and the San Joaquin. Food was abundant and easily procured and the population was large. Some of the early settlers estimated that at the time of their arrival the number of Indians in the Kaweah Delta was at least five thousand. But this region early suffered the usual results of the coming of the whites—first the Spaniards and Mexicans, soon afterward the Americans. Not only were the fertile valley lands taken possession of, but the rich harvest of acorns of the valley oaks was coveted by the hog men, who in their greed were not willing even to divide the crop with the native inhabitants. At the north end of Tulare Lake two or three tribes were rounded up by the hog men and brutally herded and driven north during the winter rains to the mountains northeast of where Fresno now stands. Many fell by the way, and some who escaped were 'taken care of on their return.' This and other exploits help to explain the almost complete extermination of the Tache, Natoonata and several other tribes. But this is not the place to tell of the outrages committed by the whites on these inoffensive people. Let it suffice that events and incidents connected with the establishment and growth of Visalia on the Kaweah River, and of the towns on Kings River, led to the destruction of numerous tribes. Nevertheless, remnants of at least nine Yokut tribes still exist. These, beginning at the north, are:

1. *Chuk-chan'-cy,* inhabiting the foothill country between Fresno Creek on the north and the San Joaquin River on the south, from a little above Fresno Flat in the lower part of the Transition or Ponderosa pine belt down to the site of old Millerton near the lower edge of the Upper Sonoran or Digger pine belt.

2. *Pit-kah'-te* (or *Pit-kah'-che*), on the south side of the San Joaquin below Millerton, in the Lower Sonoran zone. Only a few left.

3. *Kosh-sho'-o* (or *Gosh'-sho-o*), on Dry Creek and Table Mountain, in the Upper Sonoran zone. Nearly extinct.

4. *Cho-e-nim'-ne,* on Kings River at mouth of Mill Creek, and the closely related *Cho-ki'-min-ah* of Squaw Valley, both in the Upper Sonoran zone. Only a few families left.

5. *Wik-tchum'-ne,* on Kaweah River near Limekiln or Lemon Cove, on the border between the Upper and Lower Sonoran zones.

6. *Tā-dum'-ne,* formerly on Kaweah

River below Visalia, in the Lower Sonoran zone. Now nearly extinct.

7. *Na-too'-na-ta* (or *Nă-toon'-ă-tă*), formerly on Kings River north of Tulare Lake, near the abandoned town of Kingston, in the Lower Sonoran zone. Nearly extinct.

8. *Tah'-che,* on Tulare Lake, in Lower Sonoran zone. Only a few left.

9. *Yow'-el-man'-ne,* formerly on Bakersfield Plain and thence to Kern Lake, in Lower Sonoran zone. Only a few left.

THE PAIUTE TRIBES.

The country of the Paiutes, as every one knows, is the desert region east of the Sierra. The tribes of Paiute origin which invaded the Sierra and established themselves on the west slope are:

1. *Nim,* on North Fork of San Joaquin and adjacent region, in the Ponderosa pine or Transition zone. Called *Pă-zo-ōds* by their relatives, the Hol'-ko-mah. Those living in San Joaquin Canyon are called by the Wuksăche *Kash-ă-woosh-ah.*

2. *Hol'-ko-mah* (or *Hol-o'-kom-mah,* or *To-win-che'-bă*), on Sycamore Creek and Big Creek, north of Kings River, in the lower edge of the Ponderosa pine belt and upper edge of the Digger pine (borderland between Upper Sonoran and Transition zones). There is some doubt as to the proper name of this tribe.

3. *Ko-ko-he'-bă,* in Burr Valley, with one village over the divide, looking into the valley of Sycamore Creek, in the upper part of the Upper Sonoran or Digger pine belt. Only a few left.

4. *Em-tim'-bitch,* in the valley of Mill Creek, some miles south of its junction with Kings River, in lower half of Transition and upper part of Upper Sonoran zones.

5. *Wuk-să'-che,* in Eshom Valley north of Kaweah River, along the border between the Upper Sonoran and Transition zones.

6. *Pa-kan'-e-pul,* in valley of South Fork of Kern River, in the Upper Sonoran zone. They also call themselves *Te-bot-e-lob'-e-lay* (meaning pine nut eaters). The Yowelmanne call them *Wah-lik-nas'-se.*

7. *New-oo'-ah,* on Paiute Mountain and neighboring region, from Kelso Creek on the north nearly to Tehachapi on the south, in Upper Sonoran zone. The name of this tribe in the languages of their neighbors, the Yowelmanne and Pakanepul, is *Kow-ā'-sah* or *Kah-wis'-sah.*

Geographically the Paiute tribes may be arranged in two groups, separated from each other by a considerable interval not inhabited by Indians of the same stock. The first or northernmost group comprises five tribes scattered among the mountain valleys from the region about the North Fork of San Joaquin River south to Eshom Valley, namely, Nim, Hol'-ko-mah, Ko-ko-he'-ba, Em-tim'-bitch and Wuk-să'-che. All of these are unquestionably of Paiute origin.

The second group lies much farther south, in the valley of South Fork of Kern, and thence southerly over Paiute Mountain to the neighborhood of Tehachapi, and comprises two tribes—the Pa-kan'-e-pul, on South Fork of Kern, and the New-oo'-ah, centering about Paiute Mountain. Their relations are not certain.

An examination of the languages of the Paiute tribes shows at once that they are by no means equally related either to one another or to the desert Indians from whom they originally came. The five northern tribes probably crossed the mountains in comparatively recent times, for their dialects differ only slightly from one another and from that of the Petonaquats or Owens Valley Paiutes. The two southern tribes, if really of Paiute origin, must have invaded the region in very ancient times, for their tongues differ so widely from one another and from the assumed parent stock that it is only by certain common roots

that their supposed affinities appear. In fact, apart from the numerals the resemblances are very slight and it may be possible that they indicate contact rather than relationship. Further study of these Indians is greatly needed. Their reference to the Paiute stock in the present paper is only provisional.

Contrasting the distribution of the Yokut tribes collectively with that of the five undoubted Paiute tribes of the same region, it appears that the Yokut inhabit the hot San Joaquin Valley (Lower Sonoran) and adjacent foothills (Upper Sonoran), while the Paiute tribes inhabit the cooler Ponderosa pine belt of the mountains (Transition zone). Excepting the Chukchancys, who have pushed a little way into the Ponderosa pines, none of the Yokut tribes reach higher than the Digger pine belt, and only three of them (Chuk-chan'-cy, Kosh-sho'-o and Cho-ki'-min-ah) reach high enough to come within this belt.

It would be convenient to speak of the linguistic families or stocks as 'nations'—as the Paiute nation, the Yokut nation, and so on—but such a designation would be incorrect, for the reason that nothing like political unity of the component tribes exists.

As well known to ethnologists, the names of linguistic stocks often present difficulties, and the names of tribes still greater difficulties. In cases where Indians have a stock name for themselves—as the desert Paiute and Shoshone; or a tribal name—as Wuksache, Wiktchumne, Chukchancy—there is no trouble, but in cases where they have no tribal name, and such cases are common, various complications arise.

Many tribes speak of themselves as THE PEOPLE, and in numerous instances their word for people has been adopted by ethnologists (and sometimes by themselves) in lieu of a tribal or stock name. Among the family names of this class are Midu, Muwa and Yokut; among the tribal names are Nim and New-oo'-ah, both meaning people—the first from *neum* or *nüm*, the last from *new'-ah*. In some cases a locative or place name is prefixed to the stock name to distinguish the tribe—as *Ahwanee* Muwa, *Chowchilla* Muwa, and so on. In the case of tribes having no definite name for themselves it is sometimes practicable to use the name given them by another tribe—for every tribe is sure to have a name in the language of its neighbor. Such names are often based on points of the compass, meaning *north people, south people*, and so on.

While the Yokuts have no common or stock name for themselves (Yokut being the word meaning 'people' in some, but not all, of the tribes), every tribe has a fixed and definite tribal name. In the case of the desert Paiutes the opposite condition prevails, for all the tribes use the stock name, while only a few have definite tribal names. Similarly, several of the Paiute tribes on the west slope of the Sierra appear to lack distinctive names for themselves; hence the names here given for them are provisional and tentative. The doubtful names are Nim, Holkoma, Pakanepul, and possibly also New-oo'-ah; the well-established names are Kokoheba, Emtimbitch, Wuksache. Of these, Kokoheba is a place name—the name of a village—which has come to be applied to the tribe.

C. HART MERRIAM.

## *SCIENTIFIC BOOKS.*

### THE CRYPTOGAMIC BOTANY OF THE HARRIMAN EXPEDITION.*

THE scientific results of the Harriman expedition to Alaska are beginning to be made public and the handsomely bound volume recently issued gives us the first of the three

*'Harriman Alaska Expedition,' Volume V., 'Cryptogamic Botany.' New York, Doubleday, Page and Co. 1904. Pp. 404 and 44 plates.

botanical volumes promised, and includes the results of exploration in the field of the lowest plants. How little was hitherto known of some of the lower plants of this region is forcefully illustrated among the fungi, in which group only fifteen species had been definitely reported from Alaska prior to this publication. That there was no professional mycologist present with the expedition will account for the fact that only 252 species of fungi were collected by the members of the expedition or are reported for the first time in this volume. With conditions as favorable as those indicated in the introduction, the number collected might readily have been quadrupled, for a thousand species of fungi would be only an average collection to be picked up in almost any favorable locality, by a professional mycologist. Most of the species that were collected were due to the sharp eyes of Professor Trelease, who collected also most of the lichens, mosses and hepatics that were secured by the expedition. It is wholly reasonable to suppose that the results of the present expedition represent only from one eighth to one tenth of the entire fungus flora of Alaska when fully known, for we must realize that Alaska with its islands and peninsulas, if spread on the map of the rest of the United States with its upper corner at St. Paul, Minnesota, would extend from Savannah, Georgia, very nearly to Santa Barbara, California, and cover eight states and parts of a dozen more.

Among the fungi the new species are not excessive, amounting to thirty-eight, of which twenty-eight are by Saccardo or Saccardo and Scalia, five are by Trelease, one by Bresadola and four by Peck. By far the largest number are from the ascosporous series (including the *Fungi imperfecti*). The forty species of rusts form a smaller ratio to the whole than would naturally be expected. A useful host-index concludes the story of the fungi.

The 'Lichens of Alaska,' by Professor Clara E. Cummings, of Wellesley, occupies 82 pages, and includes a review of the work of previous collections from the region, so that the total of 462 species from Alaska doubtless represents more than half of the actual lichen flora of the region that complete exploration will ultimately make known. A most valuable addition to this part of the work is the series of keys to the species in each of the genera which clearly demonstrates the belief we have always held that, however much the early writers on American lichens struggled with a stilted and pedantic language to bury from view the easily discernible characters of the plants they described, lichens really possessed characters that could be easily tabulated when they were approached in a really rational way. The success with which the author has accomplished this is greatly to her credit and adds a most valuable feature to this portion of the book.

The part on the 'Algæ,' by Professor Saunders has already been published in advance of its appearance here, and is reprinted in the volume at hand with a careful preservation of the original pagination, so that citation from the original publication can be made from the present work with ease and accuracy. In the presence of so many lamentable failures on the part of editors to make this course possible, this feature is worthy of the highest commendation. The list contains 380 species of algæ, nearly two thirds of which were new to Alaska at the time of publication.

The 'Mosses of Alaska' also represents a reprint originally published in 1902 by Cardot and Theriot; 280 species are included. The hepatics by Professor Evans is also a reprint; the Harriman expedition nearly doubled the list in this group, the number of species now known from Alaska reaching 80.

The final portion of the work is by Professor Trelease and includes the ferns and fern allies. Seventy-four species are included in the list, which represents a large series when one considers so large an area belonging to a subarctic region, and yet when we consider that the central Californian 'golden-back' fern (*Ceropteris triangularis*) is found as far north as Cape Nome we are forced to the conclusion that there are climatic conditions existing in the Alaskan region that are favorable to the growth of plants of a much lower latitude as compared with other boreal parts of the earth. The plant figured as *Botrychium lunaria incisum* as 'new to Alaska' is quite typical

*B. boreale,* of which several collections have now been made from Alaska.

While the work as a whole would impress the average non-botanical reader as a list of plants merely, only those who have been engaged in distributional studies will understand the immense amount of careful and critical labor involved in the study of the material that underlies its preparation. It may be too early to form any general conclusions regarding the relations of the Alaskan flora, and it may be that the editors are expecting to include this in a later account in the two forthcoming volumes on the Spermatophytes which are expected 'in the early part of 1904,' but we are disappointed only in the absence of some more general discussion of the relations of the Alaskan flora to other regions.

The mechanical execution of the work is a great credit alike to the projector of the expedition, to the editors, and to the publishers. The heliotype plates are especially fine.

LUCIEN M. UNDERWOOD.

COLUMBIA UNIVERSITY,
May 19, 1904.

*The Eye, its Refraction and Diseases.* By EDWARD E. GIBBONS, M.D. 19 x 23 cm., pp. ix + 472, index. New York, The Macmillan Company; London, Macmillan & Co., Ltd. 1904.

The English-speaking student of ophthalmology whose special desire is to cultivate that subject as a useful art, has been much in need of a manual which should concern itself especially with the science of optics, geometrical and physiological, as applied in practise, such application being nowadays an important part of the daily routine work of the oculist.

A few years ago the elegant little 'Handbook' of Suter appeared, giving what was necessary in a geometrical line, and a short time after that Tcherning's 'Physiological Optics' was translated. Much of the subject matter of these two books necessarily enters into this volume of Dr. Gibbons, but much else has been included, sometimes in a cursory way, yet one finds here an excellent manual for the student or physician who thinks Landolt a little stiff for the first bout, and wishes the encouragement of the colloquial and sympathetic. If one expects in this volume any consideration of, or allusion to, the inflammatory affections with which text-books on 'Diseases of the Eye' are often almost exclusively concerned, he will be disappointed. Only by a liberal construction of the word disease to include refraction anomalies and muscular insufficiencies can the contents of the book be made to justify the title page. The author need not be censured for thus limiting his subject matter. Conditions of the art and of the market make it desirable that just this ground should be covered in very much this way. But the title of the book is misleading.

The first seventy-five pages are taken up with geometrical optics. In order to appreciate this part, one must know that the audience addressed is entirely made up of medical men, and that the subject matter of the address is purely mathematical. Young men who have ability and predilection for mathematics rarely choose medicine as a profession, and most physicians shy at any kind of a formula that can not be put up by a druggist. Yet a man who wishes to be an oculist finds, after six or eight years devoted to a science not particularly formal, that he is face to face with a well-developed mathematical specialty, and he is lucky if he remembers enough of his undergraduate work to help him through. An occasional one will regard this situation as refreshing—he will write the book. More will accept it with resignation, and ask for what they miscall a 'practical' knowledge of the subject, obtained by means of diagrams and illustrative cases with very little of the condensation and generalization attractive to the former. It is the delicate task of the author to give the reader all he needs of the one, and a little more than he thinks he needs of the other. The indispensable in this case is just so much of the theory of centered optical systems as will enable one to combine the three principal refracting surfaces of the eye with two others belonging to any spectacle lens that the patient may wish to wear, and to calculate the place of the cardinal points,

and the size of the images. The 'Dioptrische Untersuchungen' 'in words of one syllable' is hardly attainable, but that of it which is indispensable seems here to have been presented in the simplest possible manner. Systems are compounded and equivalent lenses calculated by the aid of Newton's formula, '$cc' = ff'$,' in which the principal foci of a system are used as coordinates from which conjugate foci are measured by a symmetrical notation. In this way a good working theory is obtained, and is so illustrated by examples chosen from the eye itself, that the student becomes familiar with the constants with which he will be subsequently concerned. Chapter V., the following, is on 'visual acuity.' From this on the science is not very much separated from the useful art by which it is likely to be applied in practise. Most of the subject matter which comes to us by or through Tcherning and Landolt appears here and is in general very well presented. The author does not hesitate to express an opinion of his own occasionally. Among other things he says the Morton ophthalmoscope is the best for refraction purposes, from which we judge the hole in the small mirror is made larger than it was in the earlier instruments. The horopter has been robbed of half its interest. This devilish contraption which kept Helmholtz awake nights and which lesser men have dodged as 'un problème de mathématiques assez compliqué et sans grand intérêt' floats in from somewhere this side of the Rocky Mountains bearing a brand new name and shrunk to nothing more or less than a toric surface. We prefer it with its old euphonious title and complicated contour.

Near two hundred pages of the book are taken up with normal and abnormal refraction. Included in this part is a chapter on optometers of some historic and theoretic interest; also a chapter on retinoscopy well presented. Retinoscopy is a *sine qua non* to a few men who paralyze all cases and do a rough-and-ready refraction practise among infirmary patients. But retinoscopy is also a necessary part of the modern oculist's equipment and deserves the space here given to it.

Dr. Gibbons in common with most other oculists thinks there is no place in the world for the 'refracting optician.' He does not devote much attention to his natural enemy, but he offers him no quarter. From a purely medical standpoint the oculist may have the best of the argument, but the refracting optician is abroad in the land and is not likely to be preached out of existence. There are economic conditions which contribute to his success and justify his claim to recognition.

It is of course quite proper that the author should give a list of cycloplegics and their peculiarities and the method of procedure to be adopted by those who habitually use them in the fitting of glasses. The number of such is so great that they can not be ignored, but why so many oculists still think it worth while to acquire the useless and irrelevant information that comes from fitting glasses to a paralyzed eye is hard to tell. It may be gathered from the text that the author thinks such a course should be the rule rather than the exception.

In the line of petty fault finding it might be said that Holmgren's color test is rather meagerly given, that the description of a Rochon prism is made to do duty for a Wollaston, that it is a little dogmatic to assert in an unqualified way that lens and vitreous opacities are caused by eye-strain. The algebra has suffered in one or two places from clerical errors, and the table at the top of page 386 seems to have been obtained empirically under conditions which, if well understood, have certainly not been accurately described.

The letter press is as good as could be desired. The illustrations that have been made for the book are excellent. Their number is greatly increased by those borrowed from the instrument-maker, whose courtesy serves a double purpose. On the whole the author, publisher and instrument-maker should be well satisfied with the accomplishment.

William S. Dennett.

New York City.

---

## *SCIENTIFIC JOURNALS AND ARTICLES.*

The May number of the *Botanical Gazette* contains the following papers: Ethel Sargant has written concerning 'The Evolution of the

Monocotyledons,' the argument being in substance that which she contributed to a discussion of the subject at the Southport meeting of the British Association. It is claimed that the monocotyledons are descended from an ancestry with two cotyledons and that the single cotyledon which distinguishes them is a member formed by a fusion of the pair. Isabel S. Smith has studied 'The Nutrition of the Egg in *Zamia*,' showing that the so-called nuclei reported to pass through the jacket-cells into the egg are the ends of haustoria sent out by the cytoplasm of the egg into the jacket-cells. Mary E. Opperman has published 'A Contribution to the Life History of *Aster*,' in which she treats of the development of the embryo sac and fertilization. Among the interesting points is a discovery of an antipodal cell fusing as an egg and about to be fertilized. J. Cardot and I. Theriot publish their second paper on 'The New or Unrecorded Mosses of North America,' describing numerous new forms. B. E. Livingston writes on the 'Physical Properties of Bog Water,' and from tests he has made draws the conclusion that bog waters do not have an appreciably higher concentration of dissolved substances than do the streams and lakes of the same region. J. N. Rose publishes a biographical sketch with portrait of the late William M. Canby. Francis Ramaley publishes a short preliminary statement of 'The Anatomy of the Cotyledons' in Cruciferæ and Ranunculaceæ.

---

## *SOCIETIES AND ACADEMIES.*

### THE GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 157th meeting, held on May 11, Mr. G. O. Smith presented a paper on 'Stratigraphic Problems in the Northern Cascades.'

In western Washington, the Eocene was characteristically an epoch of sedimentations, just as the Miocene was one of vulcanism. The Eocene sediments are economically important by reason of the coals of the Puget formation on the west slope of the Cascades, and of the Roslyn formation on the eastern slope.

Study of the Eocene formations has shown that the sediments were contributed from land areas possessing topographic diversity, and that most of the Eocene basins were neither permanent nor extensive. In the survey of the Snoqualmie quadrangle additional facts were collected concerning the relief of the pre-Eocene surface and the conditions of the Eocene sedimentation. Six Eocene formations were recognized and mapped—three being purely sedimentary and the others volcanic in part at least. The maps and sections of the folio which is in preparation will exhibit two main features; the importance of the present areas of pre-Eocene rocks as structural axes at the beginning of the Eocene, and the variability introduced into the Eocene section by the eruption of two distinct types of lava from different centers at different times. The structural axes in this region have a general northwest-southeast trend, which is paralleled by the trend of the pre-Eocene schistosity as well as the axes of post-Miocene folding and faulting and the later post-peneplain warping in the adjacent Ellensburg quadrangle.

The principal fact presented in this paper was that the present ridges of old schist and granite determined in large measure the boundaries of Eocene basins and retained their structural importance throughout the whole of the very eventful Tertiary period.

The next paper, by J. E. Spurr, was entitled, 'Faulting at Tonopah, Nevada.' In a small area, containing about six square miles, in which the most important mines and prospects are situated, the rocks are a complex of Tertiary volcanic rocks, lavas and tuffs, with a formation of lake-deposited white tuff beds. With the exception of some of the latest lavas, all these rocks have been violently and intricately faulted. The latest rocks are chiefly silicious rhyolite and silicious dacite volcanic necks, the plugs of late Tertiary volcanoes. The faults do not run into them, and the relations indicate that most of the faulting was accomplished before, during and immediately after the intrusion of the necks. The faulting is especially clustered around the dacitic necks, and examination of the fault blocks shows

that they have been noticeably dragged down along the contact of the individual necks, and that the whole later area of dacitic plugs is down-sunken in respect to the adjacent area. Thus while much of the faulting was due to the thrust of the intrusion of the necks, much of it accomplished a collapse and down-sinking around the volcanic centers, subsequent upon eruption.

On account of the extreme irregularity of the volcanic formations, due both to original irregularity and to constantly intervening erosion, it is impossible to project cross-sections underground; but in mines instructive opportunities to study vein faulting in three dimensions are offered. It is there seen that many veins are affected by intersecting systems of close-set faults, producing sometimes an intricacy almost defying analysis.

In the Wandering Boy mine, a vein is affected by two intersecting systems of faults, each system with a nearly uniform amount and direction of throw. The result of these systems is to produce a zigzag line of equal displacement, diagonal between the directions of the two systems, and the blocks are progressively down-thrown along these lines. The strike of the vein is fortuitously parallel with the trend of equal displacement, and the relation of the dip to the vertical displacement such that one offsets the other, so that drifts perpendicular to each other encounter continually fragments of the vein, which thus appears to occupy in this space a horizontal zone.

Mr. Cleveland Abbe, Jr., then presented 'The Historic-Economic Significance of the Fall Line of the Atlantic Slope.' The speaker endeavored in a few words to point out the rôle the Fall Line played in the life of the North American Indians living along its course, showing that it was marked by village sites and may have been used to define tribal boundaries.

The first European explorers probably never pushed as far inland as the falls of the rivers, and the earliest settlements also were made near the mouths of rivers and located on the coastal plain. Only after these settlements were well established did adventurers and pioneers go out from them to the more remote falls. It was also pointed out that the dates of founding settlements at the falls grow later and later from New Jersey to Alabama, presumably due to the increasing distances of those points from the coastal settlements.

The significance of the falls along the fall line for the industrial development of the bordering regions, and more especially the social and industrial changes which it is bringing about in the southeastern states, was also emphasized. This paper will be published in full in the *Journal of Geography*.

Alfred H. Brooks,
*Secretary.*

## THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 586th meeting was held May 7, 1904, Vice-President Abbe in the chair.

Mr. I. E. Fowle, Jr., presented some results of work at the Astrophysical Observatory on 'The Absorption of Water Vapor in the Infra-red Solar Spectrum.'

The quantitative investigation of the variation, due to atmospheric water vapor, of the transmissibility of our atmosphere to the incoming solar energy is the primary object of this paper. This transmissibility which decreases from band to band generally with increasing wave-length, although it increases with increasing wave-length in the separate bands themselves, is well expressed by a modification of Bouguer's formula, $e = e_0 a^{m(.23)\epsilon_0}$; $e_0$ and $e$ are the values of the solar energy of a particular wave-length before and after transmission though our atmosphere, $a$, the fractional transmission of a unit layer, $m$, the air mass traversed by the beam and $.23\epsilon_0$ is the aqueous vapor in one air mass as given by Hann's general formula, $\epsilon_0$ being the vapor pressure at the earth's surface. Aqueous vapor seems to have no general absorption between 0.7 and 2.0 $\mu$. Bouguer's formula implies the absorption by a given quantity of water in vapor as independent of its density.

Mr. S. T. Tamura then presented a condensed mathematical discussion of the problem of 'The Nocturnal Cooling of the Atmosphere.' The paper does not admit of a brief abstract.

Charles K. Wead,
*Secretary.*

## THE AMERICAN CHEMICAL SOCIETY.
### NEW YORK SECTION.

AT the eighth regular meeting of the season, held on May 6, at the Chemists Club, 108 West 55th Street, the following papers were presented:

*A Revision of the Atomic Weight of Beryllium.* C. L. PARSONS.

The paper opened with a summary of the previous determinations of the atomic weight, all of any importance having been made upon the tetra-hydrous sulphate. Following this the results of investigation upon the chloride and sulphate were given, in which it was shown that Arodejew's $BeCl_2 \cdot 4H_2O$ and Klatzo's $BeSO_4 \cdot 7H_2O$ do not exist—that the chloride is extremely difficult to obtain perfectly pure, and that the hydrous sulphates lose water so easily under different equilibrium conditions that they are not safe compounds for atomic weight data.

Determinations of the atomic weight were made upon carefully purified beryllium acetylacetonate and basic beryllium acetate. These compounds lend themselves with especial advantage to the determination of the atomic weight of beryllium as they contain no crystal water and are themselves readily crystallized and sublimed. This is especially true of the basic acetate—a compound peculiar to beryllium alone. Spectroscopic examinations of the residues made by Professor Charles A. Hutchins, of Bowdoin College, failed to detect any impurity. The average of seven analyses on the acetylacetonate and of nine on the basic acetate gave the result: Atomic weight—Be = 9.113.

Incidentally a new crystalline compound of beryllium chloride, ether, water and hydrochloric acid was described and it was shown that the black precipitate mentioned by Kress and Moralit, and which they evidently thought must contain a new substance, was a mixture of the sulphides of zinc and iron.

*The Dissociation of Lead Nitrate:* J. LIVINGSTON R. MORGAN.

Using the data of Baekeland (*J. Am. Chem. Soc.*, XXVI., 391–399), the author showed that at 357° C. the dissociation constant of the reaction $Pb(NO_3)_2 \rightleftarrows PbO + O + 2NO_2$ is 0.062 when the partial pressures in the application of the law of mass action,

$$\sqrt{p_o} \times p^2_{no_2} = \text{constant},$$

are given in meters of mercury. The presence of an excess of oxygen makes the reaction abnormal in that it favors the formation of oxygen-richer basic salts of lead; while nitrogen peroxide retains the equilibrium in the above form.

By aid of van't Hoff's formula it was also shown that at the average temperature of 262° C. the heat of dissociation is 579, the experimental value being 578 Ostwald calories. At higher temperatures the variation between calculated and observed values is great, pointing to the presence of other compounds possessing different heat values.

*The Action of Sulphuretted Hydrogen on Alkaline Solutions of Zinc Salts:* LEROY W. MCCAY.

Sulphuretted hydrogen precipitates from alkaline solutions of zinc salts zinc hydrosulphide which dissolves completely when the gas is allowed to bubble through the solution for some time. As, if sulphuretted hydrogen be passed into a solution of zinc acetate until all the zinc is precipitated as zinc sulphide, on adding a small amount of caustic alkali and again passing the current of sulphuretted hydrogen through the solution the zinc sulphide dissolves. The reaction is important, as it has a direct bearing on analysis (detection of zinc in the alkaline filtrate from manganese hydroxide). The solution soon becomes turbid from the separation of zinc sulphide. If the liquid be mixed with concentrated solution of the caustic alkalies, or with concentrated solutions of alkali salts, a white, slimy precipitate instantly separates out which contains all the zinc. It would seem that the oxygen and sulphur compounds of zinc are analogous and that corresponding to the alkali zincates there is a class of compounds which may be called the alkali sulphozincates.

*A New Separation of Thorium from Cerium, Lanthanum and Didymium:* ARTHUR C. NEISH.

Many organic precipitants were tried, most of which are weak organic acids. Metanitrobenzoic acid was found to be the best and precipitated thorium quantitatively from a neutral aqueous solution of the nitrate, while cerium, lanthanum and didymium were not precipitated.

Tables were given showing the efficiency of the separation from mixtures of pure salts in the proportions usually found in monazite sands. Five monazite sands from Brazil and two from North Carolina were analyzed by the new method and the results compared with those obtained by the 'combination' and the fumaric acid methods.

The conclusions reached were:

1. Metanitrobenzoic acid precipitates thorium quantitatively as $Th(C_6H_4NO_2CO_2)_4$ from a neutral solution of the nitrate.

2. When the precipitation is repeated it affords a complete separation from cerium, lanthanum and didymium.

3. This method gives as good results in the analysis of monazite as does the 'combination' or fumaric acid method, and has the advantage in that it is shorter and offers no difficulties in precipitation or filtration, while the precipitant is not expensive and avoids the use of alcohol.

*A Crucible Charge for Gold and Silver in Zinc Ores:* E. J. HALL and E. POPPER.

The well-known difficulties accompanying the scorification assay of zinc ores, such as the necessity of taking but a small portion for the assay, the constant attention required, etc., led to a series of experiments conducted with the hope of eliminating both the troubles inherent in any scorification as well as the special difficulties met with in the scorification of zinc blende. After various modifications of the usual crucible charges had been tried, the final charge decided upon was:

| | | |
|---|---|---|
| Ore | ⅓ | A. T. |
| Soda Ash | 1⅓ | A. T. |
| Litharge | 25 | gms. |
| Borax Glass | 20 | gms. |

This charge was tried on fourteen ores with results agreeing with or exceeding the best figures obtained by scorification. A few typical results follow:

| | | Gold and Silver. | |
|---|---|---|---|
| | Zinc. Percent. | Scorification. Ounces. | Crucible. Ounces. |
| A. | 8 | 42.50 | 42.54 |
| B. | 11.5 | 125.80 | 129.40 |
| C. | 27.5 | 135.80 | 139.35 |
| D. | 52 | 40.10 | 41.34 |

The charge is not applicable to ores containing more than 7 per cent. of copper. The proper temperature for fusion was found to be from 750°–775° C. and the time required in the furnace 35 minutes.

*A New Crucible Support:* W. E. CHAMBERLAIN.

Three pieces of pipestem are set radially in a metallic ring or in the sides of an asbestos-lined cylinder. The pipestem being movable, the points on which the crucible rests may be adjusted according to the size of the latter, and the position in which it is to be held.

*Note on Milk Analysis:* H. C. SHERMAN and A. W. HAHN.

The average results of many determinations of fat and specific gravity in cow's milk were shown and the following relations noted. Increasing richness in fat from 4.17 to 4.7 per cent. was accompanied by increasing specific gravity, but no corresponding increase of gravity was found as the fat content increased from 4.7 to 5.7 per cent. The percentage of solids not fat (calculated by Richmond's formula) rose with the fat content, though to a much smaller degree. The sum of the fat content and the lactometer reading has been proposed as a basis for the calculation of added water in cow's milk, with the claim that it is a more constant figure in normal milk than the percentage of solids-not-fat. According to the results presented, the solids-not-fat is the more constant figure of the two. and is, therefore, to be preferred as a criterion of watering or a basis for calculating the amount of water added.

H. C. SHERMAN,
*Secretary.*

THE ONONDAGA ACADEMY OF SCIENCES.

THE regular monthly meeting of the Onondaga Academy of Sciences was held March 17 in the rooms of the Historical Association in Syracuse. Mr. Guy Bailey discussed the subject of bird photography. He showed some admirable results of his work in this line. He discussed the nesting and others habits of many of our native birds.

THE April meeting of the academy was held jointly with the Onondaga Historical Association in the latter's rooms on the evening of April 20. Mr. J. S. Pennock, of the Solvay Process Company, addressed the meeting upon 'Alkali Industries.' The lecture was well illustrated with stereopticon views and dealt chiefly with the history of the Solvay process and of the Syracuse plant.

J. E. KIRKWOOD,
*Corresponding Secretary.*

THE NEBRASKA ACADEMY OF SCIENCES.

THE fourteenth annual meeting of the Nebraska Academy of Sciences was held at the University of Nebraska, Lincoln, on January 28 and 29, 1904, a goodly number of members being present and a most enjoyable and profitable program being presented.

The papers read were as follows:

*Stratigraphic Delineation of the Benton and Niobrara Formations of Nebraska:* G. E. CONDRA.

In northeastern Nebraska these two formations have been much confused, owing to the similarity in appearance of the chalk rock which occurs in each of the two layers, but a layer of Carlyle clay 200 feet in thickness on the average intervenes between them.

*The Fuel Value of the Common Cottonwood:* C. E. BESSEY.

Weight for weight, cottonwood has a higher fuel value than hickory, oak, or other woods ordinarily used for fuel, though, bulk for bulk, it is inferior. It also grows relatively more rapidly, so that for Nebraska it is a more valuable tree to plant for fuel than any other of the varieties used for that purpose.

*A Method of Preserving Insects:* A. A. TYLER.

*How nearly can Latitude and Time be found by Means of Shadows:* G. D. SWEZEY.

*Tests on Artificial Building Stone:* E. G. WOODRUFF.

*Hybridization of Oaks:* H. B. DUNCANSON.

*The Origin and Occurrence of Arikaree Quartzite:* G. E. CONDRA.

*The Fish Tape-worm, a Human Parasite new to Nebraska:* HENRY B. WARD.

Noticing the occurrence of the common fish tape-worm of Europe in persons emigrant from Russia.

*The Pronunciation of Scientific Names:* F. E. CLEMENTS.

*The Strength of Nebraska Timber:* G. R. CHATBURN.

Reviewing some recent tests made upon various Nebraska grown timbers in the course of an extensive investigation of the subject.

*New Species of Cladocera from Lake Erie:* CHARLES FORDYCE.

*A Summer's Botanizing at Bellevue, Nebraska:* A. A. TYLER.

*Building Stones of the Carboniferous of Southeastern Nebraska:* E. G. WOODRUFF.

The most important quarry was stated to be at Cedar Creek, from which forty to fifty carloads a day are shipped.

*The Status of the Botanical Survey:* F. E. CLEMENTS.

*Implement-making Materials of Nebraska Aborigines:* E. E. BLACKMAN.

*Cement Possibilities of Northern Nebraska:* G. E. CONDRA.

*Word-spectra and their Value as Tests of Authorship:* R. E. MORITZ.

*Variations in the Larval Amblystoma:* J. H. POWERS.

The causes of variation were traced on analyzing various types of variation, first, to a variable food supply, and second, to variation in habits.

*The Terraced Appearance of Tree Growth on the Missouri Flood-plain:* G. E. CONDRA.

*The Foresting of the Sand-hills of Nebraska:* C. E. BESSEY.

*Occurrence of Solifugae in Nebraska:* M. H. Swenk.

*Some Points on Dermatobia hominis* (illustrated): H. B. Ward.

The presidential address was delivered by Lawrence Bruner upon the subject, 'Migrations of Birds.'

The following officers were elected for the ensuing year:

*President*—Professor H. B. Duncanson, State Normal School, Peru.

*Vice-President*—Professor O. V. P. Stout, University of Nebraska, Lincoln.

*Secretary*—Dr. R. H. Wolcott, University of Nebraska, Lincoln.

*Treasurer*—Mr. A. E. Sheldon, Lincoln.

*Directors*—Professor J. H. Powers, Doane College, Crete; Professor G. R. Chatburn, University of Nebraska, Lincoln; Professor R. A. Emerson, University of Nebraska, Lincoln; Mr. I. S. Trostler, Omaha.

R. H. Wolcott,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### NAMATOGÆAN OR EPIGÆAN?

To the Editor of Science: I suppose every one who has had occasion to write of ecology has mentally grumbled because we have not in English a convenient short word to express what we mean when we say 'land and fresh water,' of mollusks or other invertebrates.

The German 'Binnen,' when translated into its English equivalent 'inland,' does not seem quite adequate, since the sense is rather 'away from the sea,' instead of 'not of the sea,' or 'of the land and its waters,' whether near or far from the coast.

'Land shells' seems to exclude the inhabitants of streams and pools.

Annoyed by the clumsy periphrasis which it has seemed necessary to use, I have spent some time in search for an expression, not already dedicated to some other purpose, which could be used in such cases.

*Epigæan* was at first thought of as suitable; its meaning, 'upon the earth' (earth being understood in the wide sense of land or continent), is not inappropriate, the sound is harmonious, and the word brief.

The only criticism which suggests itself is that there is nothing in the word directly implying the inclusion of the fresh-water forms.

*Gæa* was used by the Greeks for the land, in antithesis to *Thalassa,* the sea, but *Gæan* seems subject to the same criticism as *Epigæan,* while *Hydrogæan* would seem to imply inhabitants of the land-waters only and not both land and fresh water.

Many of the compounds of 'gæa' are inharmonious or too long to seem acceptable.

The Greek '*Nama,*' meaning spring, rivulet or stream (whence '*Namatodes,*' abounding in streams), seemed to offer a possible compound not too harsh or otherwise unsuitable. Would '*Namatogæan*' seem too cumbersome? I should be very glad to have suggestions from the readers of Science, some of whom may have in their inner consciousness at this moment the very term needed.

Wm. H. Dall.

Smithsonian Institution,
June 2, 1904.

### THE BLACKENING OF TEETH IN THE ORIENT.

To the Editor of Science: I do not find among my notes a good reference to the blackening of the teeth in the orient, as to the materials, utensils, motives and distribution. If you will give expression to my poverty, surely some one will help me out.

O. T. Mason.

### 'VEGETABLE BALLS.'

With regard to Professor Ganong's query on the above subject in Science, of April 8, 1904, the following reference is given in De Ioni's 'Sylloge Algarum,' Vol. IV., Section I. (1897). The reference occurs on p. iv of the Bibliography and reads: 'Barclay G—Algoid Lake-balls from South Mist—s. n. t., 8°, 1 plate.'

The reference is obviously very incomplete but it may possibly refer to 'The Scottish Naturalist' or its present continuation the 'Annals of Scottish Natural History.' South Mist is one of the Islands forming the Outer Hebrides.

J. Adams.

Royal College of Science, Dublin.

## SPECIAL ARTICLES.

### THE MECHANISM OF THE MONT PELÉE SPINE.

THE growth of the Mont Pelée spine is essentially an eruption of solid rock. Geologists are familiar with the eruption of solid material in the form of lapilli and dust, but the escape of lava in a continuous solid mass is a novel phenomenon. Naturally much interest is felt in its explanation, and the subject has been discussed by several geologists. So far as the literature has come to my attention, it has failed to include a factor which appears to me to be of prime importance, and I take the liberty, therefore, of contributing to the discussion, even though my knowledge of the Pelée eruptions is altogether at second-hand.

The phenomenon to be explained is the gradual issue of a column of rock several hundred feet in diameter and having the full cross-section of the throat of the volcano. This rock is so hot as to be incandescent, except the immediate exterior, which may be supposed to be cooled by contact with the air; but it clearly is not molten, for the mass as a whole is so rigid as to support its own weight with a height of more than 1,000 feet. While it grows by rising, its height is also reduced by the breaking away of fragments above. Allowing for this reduction, the total length of the extruded column has been estimated at 3,000 feet.

It seems to me quite clear that this process of extrusion is, properly speaking, volcanic eruption; that molten magma rising from some deep source undergoes a change of physical condition in the conduit, and is thereby enabled to issue in solid form. The process is so rapid as to preclude the hypothesis that solidification results from loss of heat by conduction. Even if surface water finds its way to the walls of the conduit, and is able there to cool the exterior part of the rising column, there can be no appreciable effect on the interior part of the column within the short time indicated by the history of the eruption. The suggestion that surface water is absorbed (as steam) by the lava and the lava is thereby cooled, encounters a double objection: (1) That rising lavas, undergoing relief from pressure, are in condition for discharging, instead of absorbing, gases; and (2) that the diffusion through the rising magma of water absorbed in the periphery of the conduit would require as much time as the cooling of the magma by conduction.

I ascribe the solidification, instead, to the escape of gases originally contained in the magma, that is, of gases contained before the magma rose in the conduit. Steam is assumed to be the principal gas; but the nature of the gas is not important to the mechanical theory. As the gas passes from the condition of absorption into the free condition, forming bubbles in the magma, it is greatly expanded, and this expansion consumes energy. The case is analogous to that of a body of air rising through the atmosphere and becoming cooler by reason of expansion. In that case the energy expended in the expansion is furnished by the heat of the air itself, and the result is a lowering of temperature. In the expansion of gas within the magma the energy is furnished by the heat of the magma, with the result that the magma is converted from a liquid to a solid condition. There may be other results from the withdrawal of heat from the magma. If its temperature was originally above the temperature of liquefaction then it may be cooled as well as solidified. Or the process may, perhaps, go somewhat beyond the accomplishment of solidification, and give to the solid a temperature slightly below the melting point. But all that is necessary to the hypothesis is that the withdrawal of heat from the lava suffices to change it from the liquid to the solid condition.

If this view is correct, then the remarkable feature of the process involved in the production of the Pelée spine is the arrest of the exclusion and expansion of the gas at the precise stage necessary for the solidification of the magma. Usually it either falls short or passes beyond; in the one case producing a liquid magma charged with bubbles; in the other bursting the solid vesicles and blowing their fragments into the air. The rarity with which the process is arrested at the completion of solidification is probably to be ascribed to the fact that it interacts on itself. The amount of gas which can be held in solution

by a particular magma depends chiefly on the pressure to which it is subject. (The influence of temperature is not important in the present connection.) As pressure is gradually relieved during eruption, more and more of the contained gas is discharged. When explosion of vesicles is once initiated at the top of the column it reduces the pressure on lower parts by carrying away some of the lava, and this loss of pressure in turn promotes the exclusion of the gas. If this view of the process is correct, the paroxysmal character of explosive volcanic eruption is strictly analogous to that of geyser eruption.

These theoretic considerations lead to the prediction that when the Pelée spine shall have become so cool as to permit of close inspection, its lava will be found to be porous. Porosity may, perhaps, not be accounted a verification of the theory, but the absence of vesicles would prove it untenable.

G. K. Gilbert.

Washington,
May 26, 1904.

---

## A SUGGESTIVE RELATION BETWEEN THE GRAVITATIONAL CONSTANT AND THE CONSTANTS OF THE ETHER.

The phenomena of radio-activity and the ionization of gases point so strongly toward the electrical constitution of matter, that the writer has made an attempt to connect the fundamental constant of gravitation with the electrical constants of the ether.

The result obtained is published with the hope that it may suggest to other physicists a more valuable extension.

The gravitational equation as ordinarily written is

$$F = k\frac{M,\ M^1}{r^2},$$

where $k$ is the gravitational constant and $M,\ M^1$ are the gravitating masses. The unit of mass is the gram. This is a purely arbitrary unit, so I have chosen a new unit of mass, which may be defined as follows: The unit of mass shall be that mass which is associated with one electromagnetic unit each of positive and negative electricity. This mass is considered to be made up of electrons, each of which has a definite mass associated with a definite amount of electricity.

The adoption of this unit of mass involves a change in the numerical value of the gravitational constant. The object of this paper is to investigate the value of this constant.

The ratio of the charge to the mass of an electron as well as the charge itself has been determined by direct experiment. The most probable value of the charge $e$ on an electron is $10^{-20}$ electromagnetic units, as measured by Mr. H. A. Wilson. The ratio $e/m$ has been measured by a number of physicists. The following are some of the best values found by experiment:

| | |
|---|---|
| Kaufmann (1898) | $1.86 \times 10^7$ |
| Simon (1899) | $1.865 \times 10^7$ |
| Lenard (1899) | $1.15 \times 10^7$ |
| Kaufmann (1901) | $1.31 \times 10^7$ |
| Wiechert (1899) | $1.42 \times 10^7$ |

The mean of the above values is $e/m = 1.52 \times 10^7$ electromagnetic units. This quantity as well as the charge $e$ is probably correct to one significant figure.

The charge $e$ as stated above is $10^{-20}$; hence the mass of an electron is $m = .65 \times 10^{-27}$ grams.

The number of electrons carrying one electro-magnetic unit of electricity is $10^{20}$; consequently the mass associated with one unit of negative electricity is $.65 \times 10^{-7}$ grams. Gravitating matter as we know it is neutral as regards charge. There must be present then an equal amount of positive electricity. The mass associated with this positive electricity will also be $.65 \times 10^{-7}$ grams; hence the total mass that is associated in the combination of one unit each of both electricities is $1.3 \times 10^{-7}$ grams.

This is the new unit of mass. The new gravitational constant may be found by substituting in the equation

$$F = k\frac{M,\ M^1}{r^2}.$$

The value of $k$ for gram unit of mass is $6{,}673 \times 10^{-11}$, from which

$$F = \frac{1}{9 \times 10^{20} r^2} = \frac{1}{(3 \times 10^{10})^2 r^2} = \frac{1}{h^2 r^2}.$$

The symbol $h$ is used because, although it is numerically equal to the ratio of the electrical units, it has not the dimensions of velocity.

The new gravitational equation may be written

$$F = C\frac{M, M^1}{r^2}.$$

The numerical value of $C$ is the reciprocal of the square of the velocity of light.

Putting

$$h = \frac{1}{\sqrt{C}}$$

we may compare it with the well-known relation

$$v = \frac{1}{\sqrt{\mu K}}.$$

On the electromagnetic system $\mu = 1$, so

$$v = \frac{1}{\sqrt{K}},$$

the above equation may be written

$$F = K\frac{M, M^1}{r^2},$$

where $K$ has the numerical value of the dielectric constant of the ether, but it is not a quantity of the same kind.

This rather remarkable relation between the gravitational constant and the constant of the ether is very suggestive. The only ratio $e/m$ that will give this result is the one above used. It is also the most probable experimental value.

It appears to me that this coincidence can hardly be accidental.

If mass is electromagnetic, then the unit of mass here used is the rational unit, and the constant of mass attraction might be expected to be related to the constants of the ether.

The above result not only suggests that matter is electrical in constitution, but that gravitational force is the same in kind if not in degree with electrical forces, and that they act in a common medium.

It may be interesting to point out the relative magnitudes of electrical and gravitational forces.

The gravitational force is

$$F = k\frac{M, M^1}{r^2},$$

and the electrical force between the electricities contained in the masses $M$, $M^1$ if they were set free is

$$f = \frac{1}{K}\frac{Q, Q^1}{r^2}.$$

From which the ratio of electrical to gravitational force is

$$\frac{1}{Kk} = (3 \times 10^{10})^4.$$

BERGEN DAVIS.

PHŒNIX PHYSICAL LABORATORY,
COLUMBIA UNIVERSITY,
May 28, 1904.

---

## *THE ROYAL COMMISSION ON TUBERCULOSIS.*

THE commission consisting of Sir Michael Foster, M.P. (chairman), Professor G. S. Woodhead, Professor Sidney Martin, Professor McFadyean and Professor R. W. Boyce has presented an *ad interim* report. It says:

"After duly considering the matter, we came to the conclusion that it would be desirable not to begin the inquiry by taking evidence—that is to say, by collecting the opinions of others (though this might be desirable at a later stage), but to attack the problem laid before us by conducting experimental investigations of our own.

"The first line of inquiry upon which we entered may be stated as follows: What are the effects produced by introducing into the body of the bovine animal (calf, heifer, cow), either through the alimentary canal as food, or directly into the tissues by subcutaneous or other injection, tuberculous material of human origin, *i. e.*, material containing living tubercle bacilli obtained from various cases of tuberculous disease in human beings, and how far do these effects resemble or differ from the effects produced by introducing into the bovine animal, under conditions as similar as possible, tuberculous material of bovine origin, *i. e.*, material containing living tubercle bacilli obtained from cases of tuberculous disease in the cow, calf or ox?

"We have up to the present made use in the above inquiry of more than twenty different 'strains' of tuberculous material of human origin—that is to say, of material

taken from more than twenty cases of tuberculous disease in human beings, including sputum from phthisical patients and the diseased parts of the lungs in pulmonary tuberculosis, mesenteric glands in primary abdominal tuberculosis, tuberculous bronchial and cervical glands and tuberculous joints. We have compared the effects produced by these with the effects produced by several different strains of tuberculous material of bovine origin.

"In the case of seven of the above strains of human origin, the introduction of the human tuberculous material into cattle gave rise at once to acute tuberculosis, with the development of widespread disease in various organs of the body, such as the lungs, spleen, liver, lymphatic glands, etc. In some instances the disease was of remarkable severity.

"In the case of the remaining strains, the bovine animal into which the tuberculous material was first introduced was affected to a less extent. The tuberculous disease was either limited to the spot where the material was introduced (this occurred, however, in two instances only, and these at the very beginning of our inquiry), or spread to a variable extent from the seat of inoculation along the lymphatic glands, with, at most, the appearance of a very small amount of tubercle in such organs as the lungs and spleen. Yet tuberculous material taken from the bovine animal thus affected, and introduced successively into other bovine animals, or into guinea-pigs from which bovine animals were subsequently inoculated, has, up to the present, in the case of five of these remaining strains, ultimately given rise in the bovine animal to general tuberculosis of an intense character; and we are still carrying out observations in this direction.

"We have very carefully compared the disease thus set up in the bovine animal by material of human origin with that set up in the bovine animal by material of bovine origin, and so far we have found the one, both in its broad general features and in its finer histological details, to be identical with the other. We have so far failed to discover any character by which we could distinguish the one from the other; and our records contain accounts of the post-mortem examinations of bovine animals infected with tuberculous material of human origin which might be used as typical descriptions of ordinary bovine tuberculosis.

"The results which we have thus obtained are so striking that we have felt it our duty to make them known without further delay in the present interim report.

"We defer to a further report all narration of the details of our experiments (and we may say that up to the present time we have made use of more than two hundred bovine animals), as well as all discussions, including those dealing with the influence of dose and of individual as well as racial susceptibility, with questions of the specific virulence of the different strains of bacilli, with the relative activity of cultures of bacilli and of emulsions of tuberculous organs and tissues, and with other points. In that report we shall deal fully with all these matters, as well as with the question why our results differ from those of some other observers."

## *THE INTERNATIONAL ASSOCIATION OF ACADEMIES.*

As we have already noted, The International Association of Academies met in London, on May 24, 25, 26 and 27 under the presidency of Sir Michael Foster. From reports published in the London *Times*, we take the following details. Lord Reay was nominated vice-president and Dr. Diels, Professor Darboux, Count Balzani and Professor Bakhuysen were appointed honorary presidents.

A resolution was passed to the effect that the initiation of any new international organization, to be maintained by subventions from different states, demands careful previous examination into the value and objects of such organization, and that it is desirable that proposals to establish such organizations should be considered by the International Association of Academies before definite action is taken.

Professor Credner moved "That this meeting recognizes the great value of the International Catalogue of Scientific Literature, and the importance of aiding the work by

making its existence known, as well as of contributing to its efficiency and completeness by endeavoring to secure the indexing of scientific publications at the time of issue, in accordance with the plan adopted by the Royal Society." Lord Reay announced that the British Academy was taking steps to publish a similar catalogue for philology, and the other branches of learning not included among the sciences of nature.

M. Boutroux gave a brief account of the work completed and contemplated in connection with the preparation of a complete edition of the works of Leibniz. Professor Waldeyer presented, on behalf of the commission for investigating the anatomy of the brain, a report of the sitting of the committee of May 24. The report stated that a meeting had been held of the invited members of the central commission and of the seven special commissions for brain investigation, and that there were present members both of the central commission and of the special commissions. Professor Waldeyer was elected chairman in place of the late Professor His, of whose memory Mr. Cunningham spoke in warm terms.

Professor Fredericq presented the report of the late Professor Marey on the work of the Institut Marey, and moved the following resolution—"The International Association of Academies approves the nomination of MM. Lippmann, Amagat, Charles Richet, Blix, Einthoven, Grützner, Langendorff, Schenck, Athanasiu as new members of the Marey Institut. After having considered the report of the late Professor Marey, dated May 5, 1904, on the work of the institute, the association congratulates the committee of the Marey Institut in having obtained in France recognition as being of public utility, and thus secured the permanence of this international scientific organization. The association expresses its best wishes for the success of the scientific work undertaken at the institute."

Sir A. Geikie, on behalf of the International Geological Congress, moved the following resolution: "The International Association having received and considered a reference made to it by the International Geological Congress held at Vienna, 1903, resolves to ask the International Geodetic Association to take into consideration whether and (or) in what way it can undertake or promote international cooperation in the investigation of the following subjects: 'Precise determination of levels in mountain chains subject to earthquakes, with the view of ascertaining whether such chains are stable or are undergoing movements of elevation or depression.' 'Measurements of the value of gravity with the object, so far as geological questions are concerned, of throwing light on the internal distribution of masses in the earth, and on the rigidity or isostasy of the terrestrial crust.'"

The president proposed Vienna as the place of meeting of the next general assembly in 1907. The proposal was adopted unanimously.

---

## *SCIENTIFIC NOTES AND NEWS.*

AT the jubilee celebrations of the University of Wisconsin the degree of doctor of laws was conferred on a number of delegates, including Henry Prentiss Armsby, director of the Pennsylvania Agricultural Experiment Station; Thomas C. Chamberlin, professor of geology, University of Chicago; Professor W. G. Farlow, Harvard University; Dr. Daniel Coit Gilman, president of Carnegie Institution; the Hon. James Wilson, secretary of agriculture; Robert S. Woodward, dean of the faculty of pure science, Columbia University; F. P. Mall, professor of anatomy, Johns Hopkins University; E. L. Mark, Hersey professor of anatomy, Harvard University; Professor S. L. Penfield, professor of mineralogy, Sheffield Scientific School, Yale University.

THE Chemical Society of London has elected as foreign members Professor E. W. Morley, of the Western Reserve University; Professor F. W. Clarke, of the U. S. Geological Survey, and Professor A. H. Becquerel, Professor C. A. L. de Bruyn, Madame Curie and Professor C. T. Liebermann.

COLUMBIA UNIVERSITY has conferred its doctorate of science on Professor Hugo De Vries, the eminent botanist of the University of Amsterdam.

On May 28 the delegates to the International Association of Academies were divided into two groups, one of which visited Oxford and the other Cambridge, where honorary degrees were conferred. We have already noted the degrees conferred at Cambridge; the recipients of the D.Sc. degree at Oxford were Professor Flechsig, Leipzig; Professor E. Ehlers, Göttingen; M. A. Giard, Paris; Dr. Victor von Lang, Vienna; Professor H. Mohn, Christiania, and Professor H. Obersteiner, Vienna.

On June 22 Oxford will confer further doctorates of science as follows: The Hon. C. A. Parsons, St. John's College, Cambridge; M. Pierre Curie, professeur de physique générale de l'Ecole Municipale de Physique et de Chimie Industrielles; Sir W. S. Church, president of the Royal College of Physicians; Sir Andrew Noble; Sir William Crookes; Sir David Gill, astronomer royal, Cape of Good Hope; Sir John Murray; Professor Alfred Marshall, professor of political economy at Cambridge; Professor J. J. Thomson, Cavendish professor of experimental physics at Cambridge; Professor Horace Lamb, professor of mathematics, Victoria University of Manchester; Professor A. R. Forsyth, Sadlerian professor of pure mathematics at Cambridge; Professor Dewar, Jacksonian professor of experimental philosophy, Cambridge, Fullerian professor of chemistry in the Royal Institution; and Professor Larmor, secretary of the Royal Society, Lucasian professor of mathematics at Cambridge.

W. F. M. Goss, dean of the Schools of Engineering of Purdue University, has received the honorary degree of Doctor of Engineering from the University of Illinois.

Professor J. M. Van Vleck, who holds the chair of mathematics and astronomy at Wesleyan University and has been a member of the faculty for fifty-one years, has been made professor emeritus, and at his own request relieved from obligation of further service.

Medical exchanges state that on his return from America recently, Professor Ehrlich was presented with a portrait medallion, by a group of sixty-five pupils and co-workers. He has been given the title of privy councilor, and is entitled to write 'von' before his name. The occasion of the presentation was his fiftieth birthday, which occurred on May 15.

Professor Svante Arrhenius, of Stockholm, lectured before the Royal Institution, London, on June 3, on electrolytic dissociation. He sailed for America on the American liner *St. Louis* on June 11.

Professor Paul Hanus, of the Department of Education of Harvard University, will spend next year abroad.

Dr. Heinrich Ries, professor of economic geology in Cornell University, will spend the summer studying the clays of Wisconsin. Mr. F. L. Gallup of the senior class will accompany him as assistant.

Wm. W. Coblentz has been reappointed research assistant by the Carnegie Institution to continue his work on infra-red radiation at Cornell University.

Miss Rose Maria Logan, and Miss Mary J. Hogue, of the Women's College of Baltimore, have been awarded scholarships admitting them to tables at the Marine Laboratory, at Woods Hole, Mass., and Miss Mary Gillespie Webb and Miss Carrie S. Bird, to tables at the Brooklyn Institute of Arts and Sciences, Cold Spring Harbor, Long Island, N. Y.

*The British Medical Journal* states that Mr. T. J. Britten, formerly manager of the Wolhuter Gold Mines, has been awarded the first prize of £500 and the gold medal offered by the Transvaal Chamber of Mines for the best appliance for the prevention of miners' phthisis. The suggested remedy is damping the dust by means of a water jet while drilling is in progress and while the blasting is taking place.

Mlle. Joteyko, lecturer on psychology in the University of Brussels, has been elected vice-president of the Neurological Society of Belgium.

The eighty-seventh annual meeting of the Société helvétiques des sciences naturelles will be held at Winterhour from July 30 to August 2, under the presidency of Professor J. Weber.

DR. WILHELM REIN, professor of education in the University of Jena, has accepted an invitation to deliver two lectures before the University of Manchester. The university will confer on him the degree of Doctor of Letters.

A BRONZE statue of Dr. Benjamin Rush, given to the nation by the American Medical Association, was unveiled at Washington on June 11. The statue, which stands in the grounds of the U. S. Naval Museum, is of heroic size. It stands on a base of Indian limestone, on which are four bas-relief panels. The one in front bears the inscription, 'Dr. Benjamin Rush, Physician and Philanthropist. 1745–1813.' One panel bears crossed swords and a wreath and beneath is inscribed, 'Signer of the Declaration of Independence.' Another panel bears a scroll, a pen and wreath with the inscription, 'First American Alienist.' The remaining panel bears the staff of Mercury, and the quotation 'Studium Sine Calamo Somnium. Mr. Louis R. Metcalfe was the architect of the statue, Mr. R. Hinton Perry the sculptor, and J. W. Pacey the builder. The statue was presented by Dr. J. H. Musser, president of the American Medical Association, and accepted by President Roosevelt. An address in honor of Dr. Rush was given by Dr. J. C. Wilson, of Philadelphia.

WE learn from the *Journal of the American Medical Association* that the street at Nancy, where Liébeault lived until his death last February, has been named after him, and will be known henceforth as Rue du Docteur Liébeault. He was the founder of the Nancy school of hypnology, and was in his eighty-second year at the time of his death.

A BRONZE medallion portrait in memory of the late Professor Adamson was unveiled at the University of Manchester on June 3, Professor Sorley, of Cambridge, making the principal address.

MR. ROBERT MCLACHLAN, F.R.S., the well-known British entomologist, whose work has been more particularly on the neuroptera, died on May 23, at the age of sixty-seven years.

WE regret also to record the deaths of M. E. D. del Castilo, the botanist, and of Professor Amato Amati, an Italian writer on geography.

THE British Association for the Advancement of Science has been invited to meet in York in 1906.

THE Station for Experimental Evolution of the Department of Experimental Biology of the Carnegie Institution at Cold Spring Harbor, L. I., was formally opened on Saturday, June 11. An introductory address was made by Director C. B. Davenport and a historical address by Mr. Walter R. T. Jones, of the Wawepex Society, which has presented land for the station. Dr. John S. Billings made an address of acceptance as chairman of the executive committee of the Carnegie Institution, and Dr. Franklin W. Hooper made an address of welcome on behalf of the biological laboratory of the Brooklyn Institute. The scientific address was made by Professor Hugo De Vries, director of the Botanical Gardens at Amsterdam.

WE learn from the London *Times* that a first report of the application of the Liverpool Cancer Research Fund, given by Mr. Sutton Timmis, as a memorial of his wife, has just been published. The fund consists of a sum of £10,000, of which an amount not exceeding £1,500 may be spent annually under the direction of a committee, the proceedings of which have been brought into close relation with the Liverpool Royal Infirmary and with the Liverpool University. In addition to a brief history of the establishment of the fund, and to a financial statement, the report contains an account, by the director of the research, Dr. Grünbaum, of the lines upon which it has been begun and will be continued. These are chiefly experimental, as it is felt that statistical and geographical inquiries may be more effectively undertaken by the London and German committees.

SOME further details are now announced in regard to the eighth International Geographic Congress, to be held in September, and for the first time in the United States. It will open at the Columbian University, Washing-

ton, on Thursday, September 8, an informal reception being held at the Hubbard Memorial Hall by President McGee of the National Geographic Society the evening before. Three days will be allotted to Washington; general meetings being held in the morning; sectional meetings and receptions and social gatherings in the afternoon. Mrs. Gardiner G. Hubbard will receive the Congress at 'Twin Oaks,' on Friday afteroon; the Smithsonian Institution on Saturday afternoon, and Commander Robert E. Peary, U. S. N., on Saturday evening. The Philadelphia Geographical Society will entertain the Congress on Monday, September 12, with field meeting and a reception; the American Geographical Society in New York on September 13 and 14, luncheon being served each day at the American Museum of Natural History; a trip up the Hudson will occupy September 15; a field meeting at Niagara Falls, September 16; Chicago will occupy September 17, and meetings on September 19, 20 and 21, will be held with the Congress of Arts and Science at St. Louis. A far west trip is planned after adjournment, and on return to Washington President Roosevelt will receive the members.

Mr. Ferrier, secretary of the Scottish Antarctic Expedition, has received and printed a letter from Mr. W. S. Bruce, the leader of the expedition, in which he says: "We have reached the southeastern extremity of the Weddell Sea, discovering there a great barrier of ice, part of the Antarctic Continent. We have gone 215 miles further south than last year, and 180 further than Ross in this part of the Antarctic regions. We got beset here in 74 S., 23 W., and were frozen in for a week, from the 7th to the 12th of March. When we got out by chance I thought it wisest not to proceed further in trying to get south and west, but to continue our program to the northeast. We sounded from here up to Gough Island and from Gough Island to the Cape, revolutionizing the map of the South American Ocean by finding relatively shallow where specially deep water was expected."

Reuter's Agency learns that the scientific expedition which left England in February under Lieutenant Boyd Alexander for the forest region between the West Coast and Lake Chad arrived in canoes at Ibi, 250 miles up the Binue River, in April. The expedition had two sectional steel boats, and other canoes with stores, etc., were following up the river. The explorers, all of whom were in good health, had already been making some collections on the Binue and intended landing at Ibi with a view to pushing north into Bauchi. It was intended that the boats should proceed further up to the Gongola River, whence they would be carried across to Yo, on Lake Chad. From the lake itself it was intended to strike to the eastward.

The American Chemical Society will, as we have already announced, hold its thirtieth general meeting at Providence, R. I., on June 21, 22 and 23. The hotel headquarters will be the Narragansett Hotel. On Tuesday, June 21, at 10:00 A.M., the first session of the meeting will be held in the lecture room of Rockefeller Hall, of Brown University. There will be an address of welcome by the president of Brown University, Dr. Wm. H. P. Faunce, followed by a response on behalf of the society by its president, Dr. A. A. Noyes. The remainder of the morning session will be devoted to the reading and discussion of papers. Arrangements for afternoon visits and excursions will be announced on the program of the meetings, or at the morning session. On Wednesday, at 9 A.M., a session for general business and the reading and discussion of papers will be held in the lecture room of Rockefeller Hall. A part of this session will be given to brief reports on researches which have been in progress in various universities and colleges during the past year. Such reports have already been promised from a number of institutions, and it is intended to make this a new and special feature of the meeting. Arrangements for afternoon visits and excursions will be announced on the program of the meetings, or at the morning session. On Thursday arrangements will be made for excursions and visits in addition to those planned for the other two days of the meeting.

A METEOROLOGICAL station of the U. S. Weather Bureau, under the charge of Mr. Alexander McC. Ashley, formerly local forecaster at Syracuse, N. Y., will be established at Honolulu.

IN response to a letter received from Mr. Calvin W. Rice, chairman of the American Institute of Electrical Engineers' Building Fund Committee, the executive committee of the Iowa State College branch of the institute appointed a local committee to solicit subscriptions from the local members and 'students' of the institute. The committee consists of Mr. B. S. Lanphear, chairman, Mr. G. W. Bissell and Mr. F. A. Pielsticker. The committee has been very successful, having raised about $700, with several of the local members yet to be interviewed. It is thought that the interest which has thus been aroused in institute matters will materially strengthen the local organization and thus eventually prove of even greater benefit to the local branch than to the institute building fund.

REUTER'S AGENCY reports that the Marconi wireless telegraph stations at Bari and Antivari (Montenegro) have now been erected for a month, and are in regular working order. Signor Marconi will personally open them in July next on his return to Italy. The high power station at Coltano (Pisa), near the royal farm of San Rossore, will be the largest in the world, and will be built entirely of stone. It will be ready in August or September, after which the engines and other apparatus will be installed, so that it may begin working not later than the beginning of 1905. The Coltano station will be able to communicate with Great Britain, Canada, the United States and the Netherlands, as well as with all vessels in the Mediterranean, the Baltic, the Red Sea, the Atlantic Ocean and the Indian Ocean. Signor Marconi has signed contracts with Chile and Argentina to construct telegraph stations.

REUTER'S Liverpool correspondent forwards information with regard to the Congo expedition which the Liverpool School of Tropical Medicine despatched to the Free State at the request of the King of the Belgians, for the purpose of studying trypanosomiasis, or sleeping sickness, in the autumn of 1903. The expedition consisted of Dr. J. E. Dutton and Dr. J. L. Todd, who formed the recent trypanosomiasis expedition of the school to Senegambia, and Dr. C. Christy, who was a member of the Royal Society's commission, sent to Uganda to study sleeping sickness. The expedition left England early in September last, and proceeded direct to Boma, where they stayed until the end of the year. At Boma the Belgian authorities attached a state medical officer, Dr. Heiberg, to the expedition, a step which was all the more appreciated from the fact that Dr. Heiberg was at one time a student at the Liverpool School of Tropical Medicine. After a stay of six weeks at Boma, the expedition proceeded to Matadi, where they remained for a few days. Dr. Dutton and Dr. Christy then went through the cataract region, their tour lasting three weeks, when they joined Dr. Todd and Dr. Heiberg, who had preceded them, at Leopoldsville. A long stay of over four months was made at Leopoldsville, where the government placed a spacious bungalow at the disposal of the expedition, and subsequently built a hospital for the special study by the expedition of sleeping sickness cases. Thanks to this the members were enabled to make careful observations, extending over several months, of sleeping sickness under the most favorable conditions possible, and to work without encountering the obstacles so frequently met with by expeditions in similar climes, who have not had the opportunity of remaining for a sufficient length of time in a suitable district under such favorable circumstances. As the cases of sickness were very numerous, a great amount of material was available, and the expedition were able to study closely all the different types of cases. Dr. Christy left for home on May 1, the other members, Dr. Todd and Dr. Dutton proceeding up the Congo River, where the expedition will continue their researches in the little-known regions of the interior. Their latest report was that they were in good health. Dr. Christy brought home with him to Europe by the *Anversville* three natives suffering

from trypanosomiasis, the disease generally known as sleeping sickness. It may be pointed out here that in a large percentage of cases in the Congo actual sleep is apparently not a marked feature in the progress of the disease. The work undertaken by the expedition has grown to very large dimensions, especially taking into consideration the expensive research being carried on in Liverpool in connection with the operations in the Congo. The work in the laboratories of the school in Liverpool consists of bacteriological and other investigations, which, owing to the lack of necessary apparatus, can not be adequately carried on in the Congo itself. The expenditure accordingly has already reached a very large sum, and the thanks of the scientific world are due to the King of the Belgians, Sir Alfred Jones, and other supporters of the Liverpool School of Tropical Medicine, whose generosity has up to the present made investigations on so large a scale possible.

---

*UNIVERSITY AND EDUCATIONAL NEWS.*

The new medical laboratories of the University of Pennsylvania, erected at a cost of $700,000, were dedicated on June 10. The building was formally presented to the university by J. Vaughn Merrick, and accepted by Provost Charles C. Harrison.

New York University has purchased land adjoining the new college building on First Avenue, between Twenty-fifth and Twenty-sixth streets, and will proceed at once with the erection of a six-story fire-proof building for the clinics and laboratories of the Medical College.

The University of Michigan has established a statistical laboratory under Dr. James W. Glover, who has charge of the work in insurance.

The main building of the Rensselaer Polytechnic Institute, Troy, N. Y., was destroyed by fire on June 9. The loss is estimated at $100,000, the insurance being $53,000. Other fires have recently occurred at the institute, and they are supposed to be the work of an incendiary.

A Board of Anthropological Studies has been established at Cambridge, the studies under the direction of the board comprising prehistoric and historic anthropology and ethnology (including sociology and comparative religion), physical anthropology and psychological anthropology.

The University of London, with the cooperation of the Teachers' Guild of Great Britain and Ireland, will organize a four weeks' holiday course for foreigners, to be held in London this summer, from July 18 to August 12, with special arrangements for those who can not join till the end of July. Professor Rippman, of Queen's College, London, has been appointed director and Mr. Cloudesley Brereton will act as adviser to French students. The inaugural address will be given by Sir Arthur Rücker, principal of the university.

Dr. Thomas M. Balliet has resigned the superintendency of Public Schools of Springfield, Mass., a position he has filled for sixteen years, having accepted the deanship of the School of Pedagogy of New York University, his resignation to take effect September 1. In accepting his resignation the committee adopted a resolution of regret and at the same time congratulated the university which is to secure his services.

Professor Angelo Heilprin, of Philadelphia, late president of the Geographical Society of that city, has been appointed lecturer in physical geography in the Sheffield Scientific School of Yale University.

At the meeting of the Board of Regents of the University of Nebraska, on May 26, Dr. Thaddeus L. Bolton, assistant professor of philosophy was made professor of psychology.

At the June meeting of the regents of the University of Minnesota, Mr. E. W. D. Holway was appointed assistant professor in botany.

At Cambridge Mr. W. J. Sell and Mr. H. J. H. Fenton, of Christ's College, have been appointed university lecturers in chemistry, and Mr. A. Harker, of St. John's College, university lecturer in petrology.